



Beyond Competence: Efficiency in American Biomedicine

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Abstract “Competence” is a longstanding value of American biomedicine. One underidentified corollary of competence is *efficiency*: at once a manifestation of competence, a challenge to competence, and a virtue in its own right. We will explore the social construction of efficiency in US undergraduate medical education through an analysis of its sociocultural and technological landscapes. We present qualitative data from two allopathic medical school field sites in the Midwestern United States, where medical students’ careful selection of certain learning resources and overall perspectives on the curriculum underscore their focus on efficiency and pragmatic approaches to knowledge. In the discussion, we consider the ethical implications of physician efficiency, as well as future trajectories for the study of efficiency in the medical social sciences, bioethics, and medical education. We posit that efficiency is at the theoretical heart of US medical practice and education: a finding that has wide-reaching implications for how researchers conceptualize the enterprise of biomedicine across cultural contexts and interpret the lived experiences of physicians, medical students, and other clinicians.

Keywords Biomedicine · Physicians · Efficiency · Competence · Ethnography

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Introduction

As observed by Mary-Jo DelVecchio Good (1999) in her classic text on the subject, *competence* is a core concern of biomedicine in the United States. Competence refers to the tangible skills necessary to provide high-quality care to patients, spanning diagnostic practices, treatment techniques, use of medical tools, and awareness of patients' cultural backgrounds, among others. Such skills are instrumentally important to the provision of medical care. Competence likewise has a deep cultural meaning, given the close relationship between knowledge, technique, and authority in the medical profession. While competence remains a central tenet of biomedicine, we argue alongside Szymczak and Bosk (2012) that *efficiency* is similarly a key value for biomedical practice that has been relatively underexplored in the sociological and anthropological literature. Efficiency, or maximizing productivity while minimizing wasted effort, is of pressing importance to clinicians today, and serves as a form of competence (as well as a threat to competence) that warrants further investigation. Physicians are contending with ever-increasing amounts of scientific and technical knowledge to master, decreasing time spent with patients to gather pertinent information and perform treatments, and the growing threat of professional burnout: all situations in which practitioners must efficiently manage their workload to successfully care for patients, and ensure their own mental well-being. In this article, we will emphasize that even from the earliest stages of education, medical students feel compelled to streamline their studies, as they are faced with an overwhelming amount of information that requires them to think critically about what to learn for exams and eventual clinical practice, and how to learn and integrate it quickly and effectively. Critical bodies of knowledge include physiology, anatomy, pharmacology, evidence-based medicine, ethics, public health, clinical and communication skills, and more.

Reflecting on the epistemological environment of biomedicine, we begin with a discussion of the literature on medical competence in relation to efficiency as a manifestation of and threat to competence, and then review current trends in evidence-based medical practice that inform discussions of efficiency (and inefficiency) in US biomedicine, particularly in light of capitalism, managed care, and the medical–industrial complex. We next compare and contrast ethnographic data from two allopathic medical schools in the Midwestern US, where medical students learn to value efficiency through the careful selection of particular learning resources and strategies. In light of these findings, we posit that efficiency is a central value of US medical education that is reflected in biomedicine at large, extending beyond competence. The role of efficiency as a touchstone of contemporary biomedicine has valuable implications for the social science of biomedicine, as well as implications for scholars in bioethics and medical education.

Before reviewing the literature on medical competence in anthropology and sociology, it is important to briefly characterize the relationship between competence and efficiency. Efficiency is at once a form of competence (learning to be efficient is a vital skill), a virtue in its own right (not always synonymous with

competence), or even a threat to competence (in that accelerating care too much may result in patient neglect and harm.) Efficiency is focused on optimization of learning and practice, rather than on the development and evaluation of skills or the standardization of training. Indeed, efficiency can even thwart competence when physicians-in-training learn to be so sparing with effort and time that they miss crucial aspects of a future patient's illness, or when they later fail to spend (or simply cannot spend) enough time with a patient to develop a complete sense of their needs and expectations for care. As ethnographic data will indicate later in this paper, medical students express anxiety over these risks of efficiency to patients. We contend with efficiency in these three ways: as a skill, a distinct cultural value, and a challenge to competence. While this paper will focus on the emergence of efficiency as a value in undergraduate medical education, we assert that this early iteration of efficiency reflects and produces North American biomedicine at large, wherein clinicians face ever-increasing pressure to provide more care in shorter amounts of time.

The Sociology and Anthropology of American Biomedicine

The qualitative findings in this paper highlight how efficiency emerges in the narratives that medical students tell about their learning and professional development. Here, we will first contextualize this work by examining how scholarship on competence, uncertainty, and sufficient knowledge informs an understanding of medical students' socialization towards efficiency, and helps us consider the broader importance of efficiency to socialization and clinical practice in biomedicine. The review of current literature will also evaluate societal trends towards efficiency within biomedical science and practice, calling to mind how efficiency has emerged as a principal value of biomedicine that diverges from existing conversations on competence.

Competence

A longstanding focus in medical sociology and anthropology on competence and related themes of expertise and professional authority amongst physicians in the United States (Vinson 2021; Jenkins 2020; Jenkins et al. 2021; Menchik 2021). highlight the social value of skill and expertise in medical practice, but do not always indicate how time and resources are managed in light of efficiency. This body of work demonstrates that competence can be a matter of technical skill (Johnson 2008; Prentice 2005, 2007, 2013), as well as the capability to manage one's emotions and behaviors in a professional context (DelVecchio Good 1999; Underman 2020, 2015; Vinson and Underman 2020; Underman and Hirshfield 2016), the ability to meaningfully consider a patients' sociocultural background in relation to their health and medical treatment (Taylor 2003a, b), and knowledge of social science that informs medical practice (Olsen 2016, 2020). While social scientists of medicine have explored many dimensions of competence, this literature has not widely

focused on how physicians streamline their work, or whether or not doing so is itself a manifestation of and/or challenge to competence. Efficiency expands these discussions of competence by considering how the factors of time and even specific available resources can determine how medical practice unfolds.

Uncertainty and Sufficient Knowledge

Outside of the research on competence and professional authority, other work has grappled with the boundaries of biomedical knowledge and practice, which meaningfully inform this paper's work on efficiency. Fox's work on uncertainty in biomedicine, for instance, posited that physicians' expertise is inherently limited due to gaps in the scientific record and changing paradigms of how natural phenomena are interpreted (Fox 1974, Fox and Fox 1980; Fox and Swazey 1978). Rather than suggesting physicians are incompetent, this research indicates that uncertainty in medicine is inevitable. In the face of such inevitability, others argue that certainty and expertise are more representative of physician practice than uncertainty (Light 1979; Atkinson 1984). Physicians and medical students alike grapple with these issues, even when socialized to perform certainty in professional roles (Haas and Shaffir 1977, 1982). Medical students learn to cope with the impossibility of knowing everything in medical school, striving to glean from their professors what content would be assessed in exams, and developing a student culture in which values around knowledge are shared amongst trainees in the medical profession (Becker et al. 1961). Uncertainty in this regard is a challenge to ignorance, while also foregrounding medical students' and physicians' need to manage gaps in knowledge within the time allotted for their studies or when caring for patients. Residents today likewise come to accept the limits of current science (Bochatay and Bajwa 2020).

Following Fox, Knopes later found that medical students are socialized to contend with the unmanageably large amount of information encountered in their studies by prioritizing some forms of knowledge over others, depending on the perceived utility of that knowledge for exams and future clinical practice (Knopes 2019, 2020, 2021). This process is identified as *sufficient knowledge*. Unlike Fox's work, this newer research noted that while scientific knowledge on a particular subject may be available, there is simply too much of it for individual clinicians to learn and utilize, generating individual uncertainty and anxiety about competence. Thus, medical students begin to value efficiency as they determine what information matters most to their education; here, efficiency is a skill that future physicians adopt, while being distinct from competence given its temporal nature.

Efficiency Logics

While sociological and anthropological research on medical education and practice in the United States has long focused on competence, efficiency is a perennial and distinct theme in contemporary biomedical education and practice. This efficiency theme occurs in the context of current trends in contemporary medical education and practice, namely evidence-based medicine and the technologies and tools

of continuing medical education, although efficiency logics are by no means limited to the context of medicine. They are manifestations of broader capitalist and Protestant ethics that time is something to be used and managed, ethics that social scientists have long described as foundational in the United States (Weber 2012 [1905]). Within the US medical context, the particular capitalist approach of “managed care” dominated starting in the 1980s and continues to be influential despite some attempts at reform (Bodenheimer and Grumbach 2020). Social scientists have criticized managed care for its focus on profitability and reliance on metrics that may not be clinically meaningful. In a poignant example, anthropologist and social worker Rebecca Lester (2011) pondered how to “code for black fingernail polish,”—a meaningful indicator of treatment progress for one patient which could not neatly be incorporated into the managed care coding and billing system. Patients and physicians have widely criticized managed care models, including how managed care logics shape health professionals’ knowledge practice (Adams and Kaufman 2011).

While the capitalist managed care model emphasizes efficiency, inefficiencies that take physicians away from the most rewarding dimensions of their work (and therefore contribute to burnout, discussed below) have also become hallmarks of medical practice under this system. The increasingly onerous electronic health record (EHR) systems, a technoscience of biomedicine within managed care (Clarke et al. 2003), not only add to this heavy clerical burden, they also risk patients’ personal narratives and values becoming lost in clinical relationships (Fox 1990, 2000; Hunt et al. 2017). Numerous articles lament waste in the American healthcare system (Swensen et al. 2011), such as the ordering of unnecessary diagnostic tests (Oren, Kebebew, and Ioannidis 2019). Importantly, these inefficiencies have received significant attention by clinicians, health policy makers, and hospital administrators: suggesting that efficiency is indeed a core value of American biomedicine that is reflected in medical education.

This capitalist efficiency logic also manifests in evidence-based medicine, a movement that asserts a particular philosophy of how physicians ought to use clinical research findings to inform medical decision-making (Duffin 2021; Howick 2011; Timmermans and Angell 2001). Specifically, it often relies on a “pyramid” or “hierarchy” of evidence, prioritizing randomized controlled trials over other research designs, and especially systematic reviews and meta-analyses (Howick 2011). Systematic reviews and meta-analyses, including but not limited to those of the Cochrane Collective, succinctly (one might say, efficiently) synthesize multiple studies and distill practice recommendations from their findings. Even beneath the systematic review level, the level of evidence pyramids/hierarchies often espouse an efficiency logic, not only ranking experimental studies over observational studies, but within observational studies ranking cohort studies which often have larger numbers of participants over case series with smaller numbers, over case reports with one or very few participants. Therefore, moving “up” the hierarchy also means increasing the number of participants described in each paper, therefore learning about more people in a shorter period of time.

The role of evidence-based medicine in medical education and practice not only encapsulates a specific logic of efficiency in science, it also expands the demands on efficiency in learning, not replacing previous foci of medical

education such as pathology and laboratory approaches (Duffin 2021), but adding to them (Guyatt et al. 1992). Students must not only learn the skills of evidence-based medicine, but also integrate evidence-based medicine with pathology and mechanistic knowledge, clinical judgment, ethical reasoning, and awareness of social determinants of health; and in practice, apply all of this often population-level knowledge to the specific case of the patient in front of them (Howick 2011; Timmermans and Angell 2001). Evidence-based medicine advocates refer to this need for integration as “the three-legged stool” of evidence-based practice, with the legs being “best available research evidence,” “clinical expertise,” and “patient’s values, characteristics, preferences, circumstances” (Spring 2007). Use of research literature is just one part of being a “competent” physician (Timmermans and Angell 2001). Students must learn to be efficient not only in learning specific material, but in integrating different types of material and sometimes contradictory ways of viewing the same situation.

Trends in technologies and tools of medical education and practice, part of broader trends in the US towards great use of mobile technologies and constant, near-instantaneous internet access in general, also embody efficiency. These trends in turn impact medical education and practice through the medical education industrial complex (Balon, Beresin, and Guerrero 2017), i.e., the proliferation of (often expensive) licensing exams and the structures that support them. Related to these exams, especially USMLE Step 1, there are a wealth of commercial preparation materials, which form an important part of what medical education scholars have dubbed the “parallel curriculum” of student learning of medical content outside or (or in place of) official curricular offerings (Coda 2019; Quirk and Chumley 2018). Students often purchase one or more independently (Burk-Rafel, Santen, and Purkiss 2017), raising concerns about student debt (Bhatnagar, Diaz, and Bucur 2019; Prober et al. 2016) and its role in racial disparities in that debt and in medical student enrollment (Bhatnagar, Diaz, and Bucur 2019). While many educators are concerned that the parallel curriculum may replace the more holistic and in-depth content of the broader curriculum (including classroom learning and faculty-assigned readings) with more surface-level content (Bhatnagar, Diaz, and Bucur 2019; Patel et al. 2015; Prober et al. 2016), some medical schools enter into contracts to provide one or more products to their students as a supplement to the curriculum (Quick of Chumley 2018) and students report their usefulness in increasing integration and cohesion of information across the curriculum (Coda 2019). Even textbooks may be used in ways other than in-depth reading due to digital access that previous generations of learners did not have: digital textbooks can serve as reference texts, with a collection of textbooks treated as a repository to search for key sections, definitions, figures, and tables (Ugaz and Resnick 2008).

While concerns about the parallel curriculum and different uses of curricular and extra-curricular materials often focus on depth, the sociology of medical education literature discussed above provides context to interpret these concerns: even the shallower depth of medical information is an unmanageable amount. The move to fast-paced digital access also affects clinical practice, with the rise of applications like UpToDate, Dynamed, and Clinical Evidence that similarly synthesize research and clinical guidelines (Andrews et al. 2017). Use of these tools also integrates with

the broader context of physician time management, namely decreasing time with patients and increasing time with electronic medical records necessitating faster investigation into patient concerns. Ethnographic data to be presented later in this paper demonstrates the high value that medical students place on such “efficient” learning resources.

Efficiency also has implications for the systemic problem of physician burnout, as individual physicians, hospital systems, private clinics, academic institutions, and professional organizations seek to make work efficient in order to reduce psychological distress. Burnout is “a work-related syndrome involving emotional exhaustion, depersonalization and a sense of reduced personal accomplishment” resulting from “chronic stress associated with emotionally intense work demands for which resources are inadequate” (West, Dyrbye, and Shanafelt 2018). Notably, inefficiency is one of the drivers of the physician burnout epidemic, including heavy burden of clerical tasks such as the EHR documentation needs mentioned above and unmanageable workloads (West, Dyrbye, and Shanafelt 2018). Researchers therefore point to potential solutions by increasing efficiency both at the organizational and personal level (West, Dyrbye, and Shanafelt 2018). At the personal level, efficiency may mean finding strategies to reduce hours spent at work overall, to limit excessive time spent at work (or taking work home). It may also mean reducing the time spent on less meaningful work, which researchers have also identified as a risk factor for burnout (Shanafelt et al. 2009). Most physicians reported that patient care was the most meaningful aspect of their work, yet they spent more time on paperwork and other tasks (Shanafelt et al. 2009). As we will explore in the results section, medical students felt similarly burned out from the intensity of their studies and preparation for clinical practice, encouraging them to streamline their work.

These trends reveal a focus on efficiency in addition to the widely documented centrality of competence in US medicine. Efficiency can in some circumstances be read as a form of competence, yet efficiency diverges from competence in that it focuses on optimization and maximizing productivity, and not just on ability or knowledge. Efficiency can also threaten competence, as will be explored later, and concern about the numerous inefficiencies in US biomedicine indicates that streamlining clinical practice remains a chief concern of physicians. In the next sections, the authors will discuss the methods of two anthropologically-informed research projects exploring medical students’ experiences around efficiency, and then discuss findings from each study that center on how medical students select efficient learning resources, and how they contend with the efficiency logics implicit in medical school curricula. This data will demonstrate that efficiency emerges as a value of American medicine from the earliest stages of physicians’ education.

Methods

The data presented in this paper is drawn from two studies at two different allopathic medical schools in the American Midwest. While the studies were not focused directly on efficiency, highlighting instead broader themes of professional socialization across peer-to-peer learning venues, efficiency nevertheless emerged in the

narratives that medical students shared. To compare data from both sites, the authors designed instruments for the second field site that adapted questions from instruments used at the first field site on efficiency and knowledge management, and then coded qualitative data drawn from surveys and focus groups at the second fieldsite using the same operationalized terms for sufficient knowledge from the first field-site study that then revealed similarities in students' responses. The first field site, given the pseudonym "Midwest School of Medicine," is a long-established, prestigious allopathic medical school where students are principally interested in becoming specialists and subspecialists. During the study period, Midwest School of Medicine comprised of 60% non-White and 40% White or Caucasian students. Approximately 50% of students were female and 50% were male based on self-identification, with no available data on students of other gender identities.

The second institution is an allopathic medical school that matriculated its first class fewer than ten years ago. It focused on preparing medical students to meet the needs of underserved populations, often in primary care. The cohort described in this study included approximately 35% male students and 65% female students, the majority of whom were residents of the state in which the institute is located. Slightly over 10% of students self-identified as underrepresented in medicine, which the AAMC defines as "those racial and ethnic populations that are underrepresented in the medical profession relative to their numbers in the general population" (Association of American Medical Colleges 2021). While the institutions have different foci, students at both medical schools were deeply concerned with studying efficiently, as the next section will highlight.

The first study upon which this paper is based was an ethnographic project carried out over 14 months between 2017 and 2018 at Midwest School of Medicine. This study entailed over 130 h of participant observation in medical school classes, as well as semi-structured interviews with 41 medical students (from first, second, and fourth years), as well as select faculty members including both physicians and basic science professors. Students were interviewed twice, once at the beginning and once at the end of the academic year, to account for any changes in their experiences over the course of their studies. Interviews lasted approximately 1 h each, and participants were compensated with a \$25USD gift card for completion of each interview. Throughout the data collection period, some additions, clarifications, and changes were made to the interview instruments based on medical student participants' ongoing feedback. The data was first coded deductively for themes around uncertainty and certainty, and then over the course of the study, inductively coded for emergent themes of ignorance and sufficient knowledge. The central finding of the project was that medical students implicitly and explicitly learned to prioritize some bodies of information over others, depending on the situation in which certain knowledge would apply, and in light of factors including reliance on peers, beliefs about future specialization, and the amount of time they dedicated to studying. The ethics protocol for the study was approved by the medical school field site's Institutional Review Board.

The second study is an ongoing medical education research project that began in the 2020–2021 academic year at the second medical school field site. This project investigated whether or not, and how, changing medical students' membership in

small-group teams impacted academic outcomes, comparing students remaining in the same group for different learning activities with students having different groups for different activities. This study included quantitative and qualitative investigation of student perceptions of the intervention. Students were invited to complete open-ended online surveys before and after the intervention, reflecting on their learning experiences and their thoughts and anticipations about the upcoming switch; and reflecting on these topics again after switching. Respondents could enter into a raffle for a \$50USD gift card to an online retailer. They were also invited to take part in a focus group. Due to the COVID-19 pandemic, the focus group was held virtually and participants were provided \$25USD gift cards to a meal delivery service. The institution's Institutional Review Board determined this study to be non-human subjects research. This paper reports on the focus group findings specifically.

Findings

Findings from these studies demonstrate that efficiency is highly valued from the earliest stages of physicians' education and socialization. This is in large part due to the structure of medical education in North America. While many medical schools and the USMLE Step 1 exam have moved to a pass/fail grading format, medical students continue to feel significant pressure to learn expansive amounts of information on a range of subjects, from pharmacology, to biophysics, to social determinants of health and ethics, to clinical skills such as physical examination, and others. Further, medical students face increasing pressure to engage in clinical research to obtain residency positions that they find desirable, meaning that they are often stretched thin given their other commitments to studying for exams and clinical rotations, participating in professional development, shadowing practicing physicians, engaging with their families, friends and communities, and finding time for rest and leisure activities. Medical students may also place undue pressure on themselves to excel, having adopted intensive study and professional development practices as college students eager to gain admission to medical school (Lin et al. 2014). These factors contextualize the ethnographic narratives and qualitative data in this section, which demonstrate how medical students valued efficiency and sought to maximize their studies in ever-dwindling amounts of time.

In particular, medical students' evaluation and selection of learning resources underscore how meaningful that efficiency is for physicians-in-training, as both a form of competence and as a distinctive virtue, as well as a challenge to competence. These learning resources span review books, flash cards, websites, and videos, amongst others, that students describe as "high yield," meaning they spare extraneous information most often found in detailed, traditional textbooks or didactic lectures (Knopes 2019). In other words, all of the knowledge contained in the resource will ideally "yield" strong exam scores. Medical students at both field sites sought resources that they believed would advance a general understanding of key concepts, necessary for success on course exams, the USMLE Step 1 exam, and the first stages of clinical practice. This similarity persisted even despite the significant difference that students at MWSOM were strongly encouraged to pursue specialization, and

students at the second field site often sought careers in primary and rural health-care. The section draws on observational field notes, interviews, surveys, and focus groups to explore the relationship between efficiency and learning resources, giving pseudonyms to all participants to protect their confidentiality.

At Midwest School of Medicine, medical students actively sought out, discussed, and selected learning resources that they believed would give them succinct information on physiology, mechanisms of action, anatomy, and diagnostic criteria. Locating these resources was critical, as students felt compelled to maximize their study time and effort by reducing the amount of seemingly extraneous information that distracted from a more nimble understanding of essential biological processes that they believed would be contained on exams and/or be most useful for clinical practice. For this reason, students eschewed traditional textbooks, which they believed contained too much irrelevant information. As first noted in another publication (Knopes 2019), one first-year student found that “textbooks go into a lot of detail and background... it’s an inefficient way of delivering knowledge.” The student preferred *Firecracker* and *Sketchy Medical*, two online platforms that seek to enhance recall of biomedical information through flash cards and images, rather than blocks of text on a page where the most central concepts are not always readily apparent. Charlie, a second-year student, was a lanky man with a mess of auburn hair who often reflected on his education using metaphors and poetic turns of phrase. With notable self-insight, he shared in an interview that “I would read Harrison’s or Boron [two traditional textbooks], but I would lose the forest for the trees.” Instead, Charlie would “triage the knowledge” by first reading Wikipedia entries to gain an initial understanding of a topic, and then turning to *First Aid for the USMLE Step 1* and *Pathoma*, a book and website respectively that both provide concise overviews of key material for the USMLE Step 1 exam at the end of students’ second year. In Charlie’s mind, these sources lent a strong foundational knowledge on essential topics that would lay the groundwork for his initial work as a medical resident. Charlie expressed a genuine curiosity about medical science as well as bioethics and the humanities, but had made peace early in medical school with the reality that streamlining his studies sometimes meant foregoing lengthy forays into the literature.

Other students at MWSOM justified narrowing the scope of their studies because they could afford to spend more time exploring their specific area of interest as future specialists. First-year medical student Angela was passionate about embryology and hoped to become an obstetrician, and understood that while there was little time spent in the undergraduate curriculum on fetal development and even less time to study it, she would have ample opportunity to explore this topic later in her career. One fourth-year student in the study, Kyler, was a rugged California-born outdoorsman who never fretted much about cramming for exams and clinical rotations. He shrugged during an interview as he explained that in his chosen specialty (emergency medicine), he could fast-track patients to care by rapidly stabilizing them and then passing them along to internists and surgeons: indicating both that efficiency mattered to his eventual practice, and that he could afford to overlook certain concepts as a medical student that would not apply to his future specialty. Students at the second medical school fieldsite, where the administration emphasized its desire to produce primary care

physicians, did not often frame their interests in terms of future specialty but did acknowledge the pressure they felt to expedite their studies on certain topics as there was simply not enough time to learn everything, as other research has indicated (Knopes 2021).

Students similarly expressed frustration with textbooks during classroom observations. In one small-group class session at MWSOM, a student complained about how little they understood about kidney function after reading a textbook chapter. They lamented, “I should have just watched the five-minute *Boards and Beyond* video and cut off my studying there.” The students in the group, including women and men of diverse racial and ethnic backgrounds, all nodded collectively. Fellow students in the group recommended watching such videos at 1.5 times the normal playback speed to maximize the amount of content that could be reviewed in a given period of studying. A fourth-year medical student facilitating the session agreed with these sentiments, reminding the group, “All you really need to know is [in the] Step 1 *First Aid* book.” Pre-clerkship medical students trusted such perspectives from fourth-year colleagues, who had recent knowledge of what material would be included on course exams and the USMLE Step 1 exam, as well as what knowledge was most pertinent for third-year clerkships and acting internships in the final year of medical school, prior to residency. Both within and outside of class meetings, students from all four years of undergraduate medical education adopted the metaphor “drinking from a fire hose” to characterize the impossibility of internalizing all of the information presented in the course of their studies, rendering calculated study efforts necessary if they were to master what they believed were the most indispensable concepts. Efficiency was thus highly valued, while learning to choose the resources that would optimize their studies became an important skill for coping with the enormity of biomedical knowledge encountered in their education.

At the second field site, medical students similarly weighed learning resources depending on how efficient such sources would be for their studies outside of the classroom, which they expressed in a lively focus group held over WebEx and through confidential surveys distributed to all students at the medical school. Students likewise rejected textbooks and found other ways to be efficient. One student explained, “I very rarely touch a textbook and I haven’t touched a textbook in years because it’s not efficient for me and the biggest thing in med school is that we don’t have enough time to touch everything. I need to be efficient with my time.” This student preferred videos because “I’m a visual person” and “if I’m only doing 5 pages in 2 h versus a 10-min video on Osmosis, I’m going to go with a 10-min video.” A student stressed the importance of flexibility in choosing (shorter, more efficient) videos over textbook resources. Another student reported that in one class “I often found that the video resources did not go to the depth that I felt we needed for the quiz questions.” They therefore used textbooks to learn more in that class, but in another class “I don’t think I touched the textbook at all, and I used a lot of the video resources.” This student’s selection of videos versus textbooks “also changed based off of how the content was presented and what we were covering and how it was presented in different resources. So, I think that flexibility is really important, just to be able to adjust and change as you need to succeed.” Another student in a remote

team-based learning class, whose appearance was concealed as they had turned off their webcam for the session, suggested that the group hold a coin toss rather than reflect on textbook content to decide which answer was correct for one particularly difficult question.

Students at the second field site also discussed efficiency when reflecting on the team-switching study itself. One student noted, “There were probably like, a couple of times where something came up in one group’s case, and it didn’t come up in another group’s case. So we got to kind of learn from each other. But overall, I think it made it a little bit less efficient because we didn’t really have a ton of time together, like, we were only [a] hybrid group for six weeks for an hour at a time.” This comment addresses less the team-switching practice, and more the general preference for efficiency and how it comes into play in the course of the study’s cross-over design, where any given student only switched small group team membership for 6 or 7 weeks, depending on the course.

Despite a general preference for efficiency, students and faculty at both field sites recognized its pitfalls, and often expressed anxiety about the potential consequences of cutting corners. At MWSOM, pre-clerkship medical students in one small group circulated a meme from the website Reddit between one another and to the ethnographer. The meme depicted a physician dressed in a white coat consulting with a patient and a patient’s family member. In the first panel, the physician mourns that there is little that they can do to assist the ailing patient. In the second, the physician admits that this is because the patient has “the disease from the chapter which I left as optional during my studies.” Students in the group laughed at the meme yet fretted if someday they would be in a similar position, having unwittingly skipped over content that became critical to their future practice. At MWSOM, students also had complicated feelings about balancing time in other ways. During the small group discussion meetings on Mondays, medical students at this fieldsite frequently shared what they had done over the weekend. They teased students who admitted to studying for the majority of the weekend and lauded students who had done something for leisure, like hiking or baking. Yet the same students that were praised for unwinding expressed worry about misusing time that could have been spent preparing for upcoming exams or for completing written assignments. Thus, medical students were concerned about skimping on their studies and how to capitalize on their time outside of the classroom in order to succeed in medical school. Participants at both field sites were conscious of the perils of efficiency for patient care and for academic performance.

As this qualitative data reveals, undergraduate medical students in the United States make deliberate choices around what learning resources to consult in their studies. These choices are born out of the impossibility of knowing everything, and the belief that general understanding of key biological processes is more useful than detailed scientific accounts when taking exams and preparing for the first stages of clinical practice. Students select resources like review books for the USMLE Step 1 exam, online flashcard platforms, and visual learning tools which they believe contain only the information most likely to be contained on exams or in clinical practice. In so doing, medical students feel that they utilize their study time effectively, while turning away from traditional textbooks that strike them as containing too

much ancillary knowledge that would distract them from a more deft understanding of critical concepts. Medical students also recognized the potential costs of streamlining their learning, including patient harm. In these ways, efficiency is negotiated at the local level, while being reflected by larger trends in American biomedicine towards greater optimization of care.

Discussion

Efficiency emerges as a key virtue in US biomedicine both in macro-level trends in medical science and technology and in the local narratives of medical students about their studies and future patient care careers. Although the two studies occurred in very different medical schools with different missions, foci, and student demographics, students in both settings similarly raised concerns about efficiency. In particular, students' perspectives on efficiency did not correlate to their racial identity, although students at MWSOM did reflect on the impact of their race, culture, and gender on other aspects of their professional socialization that are beyond the scope of this paper. Efficiency both comprises and challenges competence, and as such, should be reflected upon by medical educators, social scientists of medicine, and bioethicists, all of whom might address different dimensions of efficiency and its impact on clinical practice and patient safety. In comprising competence, efficiency itself is a skill in which students must develop competency. In other words, to become a competent physician, a medical student must learn to be efficient, given the practical constraints around knowledge and clinical work. As the previous section indicated, one way that medical students learn to be efficient is through the careful selection of resources that offer the appropriate amount and scope of information for exams and future practice, while sparing extraneous knowledge that would not advance a general understanding of biomedicine for clerkships and early residency. In these ways, efficiency is a key part of professional development. Educators can potentially model efficiency in a healthy way by helping students select high-quality learning resources, by describing their own strategies for reviewing and implementing current literature, and by sharing case examples from their personal experience that underscore the benefits and drawbacks of efficiency in biomedicine.

To the contrary, in challenging competence, efficiency may bring with it risk of missing key knowledge. Students who participated in the studies explored here worried about the ethical implications of efficiency. For instance, if they failed to learn about a rare disease, side effect, or presentation, might they fail to recognize these conditions in patients? Certainly, rare disease advocates and scholars have criticized the common push in medical education for students to “think horses” (the common condition) not “zebras” (the rare condition) which may lead to overlooking rare conditions (Roscoe 2017), though the maxim entails keeping zebras in mind while dismissing them (Hunter 1996). Scholars therefore advocate for rare disease education in medical school, while recognizing the impossibility of teaching every detail about every disease, and focusing instead on more common rare diseases and on general trends in patient experiences (Cismondi et al. 2015; Groft et al. 2019). These pragmatic epistemological decisions can put patients at risk whenever incomplete

knowledge leads to misdiagnosis or failure to treat an underlying condition: indeed, as qualitative data reveals, medical students have concerns about this possibility. Here, bioethicists will have a clear interest in efficiency, as a value of clinical practice that might endanger patients, and that deserves further philosophical reflection: especially as incomplete knowledge is inevitable for individual clinicians. Rare diseases are one example of many that demonstrate the inability to teach and learn every detail of medical knowledge, and the importance of efficiency in medical education.

Beyond clinical practice and education, medical anthropologists and sociologists might further explore the role of efficiency in biomedicine and in other medical systems across cultural contexts. Certainly in the United States, efficiency is a crucial facet of the epistemological culture of physician practice, and as such should be considered in analyses of knowledge, expertise, and socialization in the medical profession. While this article describes the value of efficiency for US medical students and physicians, social scientists can and should consider whether and how efficiency is an important factor in other types of clinical practice, including nursing, dentistry, social work, occupational and physical therapy, and other healthcare professions: both in the United States and in other places where biomedicine is present. Anthropological analyses should consider the differences in what efficiency means across sociocultural contexts, as conceptions of time, resources, and optimization may not be the same as in the United States; further, the relationship between competence and efficiency may diverge in other cultural settings and communities (Brada 2011, Wendland 2010).

Notably, practitioners in non-biomedical systems may still feel compelled to streamline their work, especially when these practitioners interface with global biomedicines, where efficiency can be highly prized. Conversely, efficiency may not be a central principle of biomedicine in resource-limited settings where information cannot be rapidly accessed or distributed online, or in settings where practitioners are not time-limited in their visits with patients. Thus, social scientists may have much to gain from a consideration of efficiency in their work on medical practice across the world, especially as global medical practices around efficiency may carry important lessons for the United States on how to best manage time, resources, and knowledge in healthcare and health professions education. In these ways, efficiency has interdisciplinary implications across medical social science, bioethics, and medical education, and scholars in these fields should pay close attention to the consequences of efficiency as a value for contemporary clinical practice.

Conclusion

Scholarship in medical anthropology and sociology has rightfully focused on competence as a core tenet of biomedicine in the United States, especially in the relationships between skill, expertise, and professional authority amongst physicians. Through data on trends in contemporary medical practice and education, and through ethnographic accounts of medical students' experiences at two institutions in the Midwestern US, this article argues that efficiency is a form of competence: the

skill of optimizing knowledge acquisition and the delivery of care. Efficiency is critically important for physicians in the United States, who are grappling with increasing workloads and rates of professional burnout. Efficiency is also deeply meaningful for medical students, who confront the impossibility of absolute knowledge from the earliest stages of their education. Far from only a skill, however, efficiency is a value in its own right, and a potential challenge to competence when individual clinicians streamline their work to such a degree that key information about a patient's case is overlooked. Scholars across the disciplines of social science of medicine, bioethics, and medical education all have a stake in discussions of efficiency, from determining the cross-cultural and interprofessional nature of efficiency as a social value, to exploring the ethical risks of efficiency for patients, to assisting medical students as they learn to manage significant amounts of clinical and scientific knowledge. In all, efficiency is a fundamental part of the epistemology of biomedicine, alongside and beyond competence.

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Declarations

Conflict of interest The authors have no conflicts of interest to disclose.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the Institutional Research Committees and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in these studies.

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